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MASSACHUSETTS COASTAL COMMERCIAL LOBSTER TRAP SAMPLING PROGRAM MAY-NOVEMBER, 1984

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COMMONWEALTH OF MASSACHUSETTS
Department of Fisheries, Wildlife, and
Environmental Law Enforcement
Division of Marine Fisheries

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ABSTRACT

The fourth consecutive American lobster (Homarus americanus) catch/effort and biological monitoring program was completed in Massachusetts coastal waters in 1984. Six lobstering regions were sampled monthly, during the major lobstering season, May-November. With the cooperation of coastal commercial lobstermen, a total of 16,513 lobster were sampled from 9,138 trap hauls during fifty-three trips aboard commercial lobster vessels.

The 1984 coastwide mean catch per trap haul-set-over-day indices for all lobster, legal, and sublegal size groups were 0.638, 0.219, and 0.418, respectively. These indices decreased from 1983 by 22%, 21%, and 22%, respectively. Catch per trap haul index trends were similar but declined by only 14%. Estimates of exploitation and total annual mortality remained high. Over 90% of the lobster landed in inshore regions were new recruits (42% east of Cape Cod). The coastwide mean carapace lengths were static at approximately 82 mm, 90 mm, and 76 mm for all lobster, legal, and sublegal size groups, respectively. A weight-length relationship was developed and a significant difference was found between the slopes of male and female regression lines. Males weighed more than females at sizes $\geq$ 97 mm. The percentage of females ovigerous was 9.1% which declined 1.8% from 1983. Thirty-eight percent of all lobster sampled during 1984 were males compared to 41% during 1983. The percentage of culls increased to 14.8% from a relatively stable 10-11% during the 1981-1983 period. Trap mortality remained at less than one percent.

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INTRODUCTION

The commercial lobster fishery is the most economically important single-species fishery in Massachusetts coastal waters. For many years this fishery has been monitored by the Massachusetts Division of Marine Fisheries (DMF) Commercial Fisheries Statistics Project. Selected lobster fishery statistics are compiled from catch reports filed annually by lobster license holders. However, coincident with the inspection of the State-Federal Lobster Management Program, and ultimately the American Lobster Fishery Management Plan (FMP)[1], the need for a comprehensive, coastwide, organized American lobster management effort was recognized. According to the precepts of the FMP, a long-term statewide monitoring program which would yield biological as well as catch per unit effort data was devised and initiated in Massachusetts in May, 1981. A sea sampling survey design was adopted by which both catch per unit effort and biological data could be collected temporally and areally with sufficient precision for stock assessments. The objective was to assess variations in population parameters due to environmental and/or fishing pressure, or the effects of regulatory changes.

The following report summarizes the data collected during the 1984 coastwide commercial lobster trap sampling program in Massachusetts coastal waters. Comparisons to 1983 survey results are presented.

STUDY AREA

The study area is primarily defined by the Massachusetts territorial sea, except where lobstering activities of cooperating commercial lobstermen exceeded territorial boundaries (Figure 1). Territorial waters total 5322 sq. km. (2055 sq. n mi), of which an estimated 60% is considered major lobster habitat. Five sampling regions, Cape Ann, Beverly-Salem, Cape Cod Bay, outer Cape Cod, and Buzzards Bay, were chosen for coverage of the major lobstering regions of the state within resources available. For convenience, these regions are depicted as generalized hatchmarked areas wherein lobster gear sampled may be discontinuously distributed.

Three major lobster population groups are defined within Massachusetts coastal waters: Gulf of Maine (including Cape Ann, Beverly-Salem, and Cape Cod Bay regions), outer Cape Cod, and Buzzards Bay.

SAMPLING PROCEDURE

Coverage of coastal waters was accomplished by monitoring catches during the normal lobstering operations of volunteer commercial lobstermen in each

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[1]American Lobster Fishery Management Plan, New England Fishery Management Council, Saugus, Massachusetts, March, 1983.

designated region. Multiple lobstering operations were observed to reduce bias from varying degrees of lobstering skill and to enhance areal coverage. Five lobstermen were monitored in Gulf of Maine regions, three in the outer Cape Cod region and three in Buzzards Bay. Pot-sampling trips were day trips, conducted a minimum of once per month per region (except when manpower limitations precluded effort or cooperating lobstermen were not operating during the major lobstering season, May through November).

Utilizing portable cassette tape recorders, sea samplers recorded carapace length to the nearest mm and to the nearest 0.1 mm between 80.5 and 81.0 mm; sex; and condition, including the degree of shell hardness, culls and other shell damage, external gross pathology, mortality, and presence of extruded ova on females (ovigerous). Catch in number of lobster, number of trap hauls, set-over-days, trap and bait type were also recorded.

ANALYTICAL PROCEDURES

Data were computer coded and keypunched for analysis on the Woods Hole Oceanographic Institution's Digital Equipment Corporation VAX-11/780 computer system. A computer auditing process was used to uncover keypunch and recording errors and statistical analyses were performed with SPSS (Nie et al. 1975) and BMDP (Brown et al. 1979) statistical subprograms.

Because parameters means exhibit significant regional and monthly variation, an areal and temporal data weighting scheme was incorporated into analytical software. Presently, each month's data contribute equally to regional parameter means which are weighted by area in square nautical miles.

Unless specified otherwise, the terms "legal" or "legal sized" lobster include all lobster in the carapace length category $\geq$ 81 mm. The marketable segment of this category, which excludes ovigerous females, is analyzed separately and is referred to as marketable lobster. The sublegal length category includes all lobster $<$ 81 mm.

Lobster landings and effort (number of traps) data quoted is derived from lobstermen's catch reports which are compiled annually by the DMF Commercial Fisheries Statistics Project.

Since current management strategy stresses uniform coastwide regulations, all data are grouped for a coastwide analysis. However, the uniqueness of the Massachusetts coastline, its role in providing a temperature barrier which profoundly affects many marine species (Colton 1964), and the influence of offshore lobster stocks on the inshore population mandate a regional data treatment as well.

RESULTS AND DSICUSSION

During the period of May through November, 1984, fifty-six traps were made aboard commercial lobster vessels in Massachusetts coastal waters. A total of 16,513 lobster were sampled from 9,138 trap hauls.

Abundance

The coastwide mean catch per trap haul-set-over-day (CTHSOD) for 1984 for all lobster was 0.638 which declined 22% from 1983. The catch rate index for legal sized lobster decreased by 21% to 0.219. Catch rates for marketable lobster, 0.201 and sublegal lobster, 0.418, declined 19% and 22%, respectively (Tables 1-4).

Catch per trap haul (CTHAUL) index trends were similar. They decreased from 1983 by 14% for all size groups except marketable lobster which declined by 11% (Tables 5-8).

All regional CTHSOD estimates for each size group declined in 1984 except those for Buzzards Bay (Tables 1-4). Cape Cod Bay exhibited the largest deficit. Most regional CTHAUL estimates for each size group also declined.

The relationship between catch per trap haul and soak time is not linear; it is asymptotic. This may be responsible for the disparity in the 1983-1984 percent decline between CTHAUL and CTHSOD indices. Work is underway to incorporate a model of the CTHAUL soak-time relationship into analysis programs in order to standardize soak time and enhance the accuracy of catch rate calculations.

Nevertheless, an evaluation of landings data compiled from lobstermen's catch reports helps to explain the 1984 deficit. Historically, approximately 80% of Massachusetts' commercial landings from within 69 W Longitude 41 N Latitude came from Massachusetts territorial waters (approximately 70% of all Massachusetts commercial landings). The 1984 estimated landings from within the territorial boundary decreased by 7% from 1983; coastal lobster landings inside 69 W 41 N decreased by 3% and offshore landings (outside 69 W 41 N) increased by 22%. It appears from these data that at least legal sized lobster were more available in deeper water during 1984.

Cooler than normal water temperatures were reported during spring, 1984. These may have depressed early season molt probability inshore causing abnormally low spring catch rates. Campbell (1983) observed the dependency of molting on water temperature and total degree days above 5° C.

Generally, a more optimal temperature regime exists in deeper offshore waters. This enhances activity and catchability; however, increased effort may have contributed to the large offshore catches. These catches and good recruitment from the autumn molt period enhanced annual landings during 1984 to a total 12,604,065 pounds (12,259,311 pounds commercial).

The trend in abundance of the pre-recruit molt group mirrored the inshore landings and legal catch rate trends which peaked in 1983 and declined in 1984; recruitment followed this trend but actually began declining in 1983 (Figure 2).

Exploitation Rate

Estimated exploitation rates remained high (Table 9). Approximately 89-94% of the lobster landed in inshore regions were captured shortly after molting beyond the legal size limit of 81 mm. This index was 42% for the outer Cape Cod region where a large offshore migrant group dominates catches. The coastwide index was 86%.

Mortality

Total annual mortality estimates varied little from 1983 ranging from 85% (Cape Ann) to 96% (Buzzards Bay) in inshore regions and 28% off outer Cape Cod when computed by the method of Gulland (1969). Estimates by the Beverton and Holt (1956) method ranged from 78% (Cape Ann) to 89% (Buzzards Bay) for inshore regions and 41% off outer Cape Cod (Table 10).

Carapace Length

The mean carapace length of all lobster sampled during 1984 was 81.7 mm which was unchanged from 1983 (Table 11). Lobster $\geq$ 81 mm carapace length averaged 90.5 mm (90.4 mm in 1983, Table 12). Marketable lobster averaged 90 mm (89.7 mm in 1983, Table 13) and the mean length of sublegal sized lobster was 76.1 mm (76.2 mm in 1983, Table 14). Size frequency data by state and region (Tables 15-21) did not reveal any major distribution changes from 1983. This minimal variation in size may be due to the fact that this intensively exploited fishery is recruitment dependent. Nearly all lobster landed are new recruits. Consequently, potential variation in mean size from variable year-class strength, and/or intensity of seasonal inshore migrations of larger offshore lobster is likely to be mitigated by fishing pressure.

Weight-Length Relationship

Between 1980 and 1985 lobster carapace lengths and corresponding body weights were collected at dealers in six coastal Massachusetts regions. In order to determine the weight-length relationship, only lobster in the 81-120 mm size range, excluding culls, were analyzed yielding a sample size of 4155 (2043 M, 2112 F). A logarithmic transformation of the data was fitted to the equation $W = aL^b$ by the method of least squares to provide the following relationships:

$$W = 0.0007634 \; L^{3.01397} \text{ (sexes combined)}$$

$$W = 0.0004942 \; L^{3.10929} \text{ (males)}$$

$$W = 0.0010652 \; L^{2.94118} \text{ (females)}$$

A highly significant difference was found between the slopes of the male and female regression lines ($P < 0.000001$). Females weighed slightly more than males at each mm increment from 81-96 mm. At 97 mm and larger a reversal occurred (Table 22). This was probably related to the gradual attainment of sexual dimorphic characteristics with the onset of maturity. The significant changes which occur in the abdominal width of females and cheliped size of males may be responsible.

Weight and length data were collected throughout the seasons and expected weights for a given length are considered to be annual means. Body weight varies seasonally relative to the molt and is usually lower during summer and autumn, following molting, than during winter and spring.

Thomas (1973) found no significant difference between male (N = 336) and female (N = 391) regression lines when investigating the weight-length relationship in Maine lobster. His tests were run on sublegal and legal sizes. Briggs and Mushacke (1979) also found no difference between male (N = 52) and female (N = 52) lobster weight-length relationships in western Long Island Sound. Their samples ranged from 17-118 mm carapace length. However, Campbell (1983) observed a significant difference ($P < 0.01$) between the slopes of male (N = 135) and female (N = 197) regression lines for lobster (47-144 mm) from Port Maitland, Nova Scotia.

Percentage of Females Ovigerous

The percentage of females ovigerous during 1984 was 9.1 (Table 23) which declined by 1.8% from 1983. Similar declines occurred in both legal (Table 24) and sublegal (Table 25) size groups. Minimal declines occurred in all regions for each size category with one exception: sublegal "eggers" in the outer Cape Cod region increased from 1.0% in 1983 to 1.4% in 1984. Buzzards Bay sublegal egg bearing females exhibited the largest decline (8.5%). Declines may have been directly related to cooler than normal spring water temperatures which delayed egg development and extrusion. Females carried maturing eggs later than usual during this season and new egg extrusion also occurred later and apparently less frequently than the previous year.

Regional differences in female size at maturity are evident in Figure 3. Approximately 60% of the Buzzards Bay "eggers" are smaller than legal size, compared to approximately 40% in Gulf of Maine regions, and less than 1% off outer Cape Cod. These characteristics also persisted throughout 1981-1983 data.

Carapace Length of Ovigerous Females

The mean carapace length of ovigerous females was 87.4 mm which decreased from the 1983 mean of 88.6 mm (Table 26). Similar declines occured in all regions except Buzzards Bay where average length increased by 1.4 mm. This may have resulted from the large 1984 deficit in sublegal eggers there; however, mean size steadily increased over the 1981-1984 period. The mean carapace length of egg-bearing females $\geq$ 81 mm (94.0 mm) followed a similar trend (Table 27). Sublegal sized ovigerous females decreased in mean size from 77.9 mm in 1983 to 76.4 mm in 1984 (Table 28). Declines occured in all regions except Cape Ann where the mean (79.9 mm) increased by 1.4 mm from the previous year. The percentage of ovigerous females larger than 80 mm was once again greater off Cape Ann and outer Cape Cod (Table 29) suggesting that greater influence from larger offshore migrant lobster occurs in these regions.

Sex Ratio

Thirty-eight percent of all lobster sampled during 1984 were males (Table 30). This was 3% lower than in 1983. Similar declines occurred regionally except Cape Cod Bay where males comprised 36% of the catch during both 1983 and 1984. Legal and sublegal size categories (41% males and 36% males, respectively) exhibited similar trends (Tables 31 and 32).

Variability in sex ratio may occur by depth. Sex ratios calculated for deep water populations are biased toward females. The declines in the proportion of males in 1984 may have resulted from increased fishing in water where lobster were more available.

Cull Rate

The percentage of culls among all lobster sampled during 1984 was 14.8% (Table 33). This represented a significant increase from the 10-11% rate which characterized the previous three years. Legal, sublegal, and marketable size categories exhibited similar trends (Tables 34-36).

Until 1984, Buzzards Bay exhibited the highest cull rate which was possibly related to its high exploitation rate (highest among coastal Massachusetts regions). In 1984, most regions' cull rates increased substantially while the Buzzards Bay rate remained unchanged.

One possible cause may be enhanced fishing effort from mobile and other fixed gear fisheries. Studies in Connecticut (Smith et al. 1985), Rhode Island (Ganz 1980), and Massachusetts (Currier 1984) indicate that shell damage and cull rate are enhanced by bottom trawl activity. Gill net operations may also be responsible. Such escalated non-trap fishing activity directed at lobster, concurrent with the present decline in finfish resources, is a plausible explanation.

Trap Mortality

Percent trap mortality for all lobster sampled during 1984 was 0.15 compared to 0.22 in 1983 (Table 37). Indices for legal and sublegal size groups were also less than one percent (Tables 38-39). Although this parameter may vary seasonally and can be enhanced by environmental stresses, molting, intra- and interspecific aggression during entrapment, pollution, or the synergistic affect of these, it appears that the annual means do not indicate a major problem at this time.

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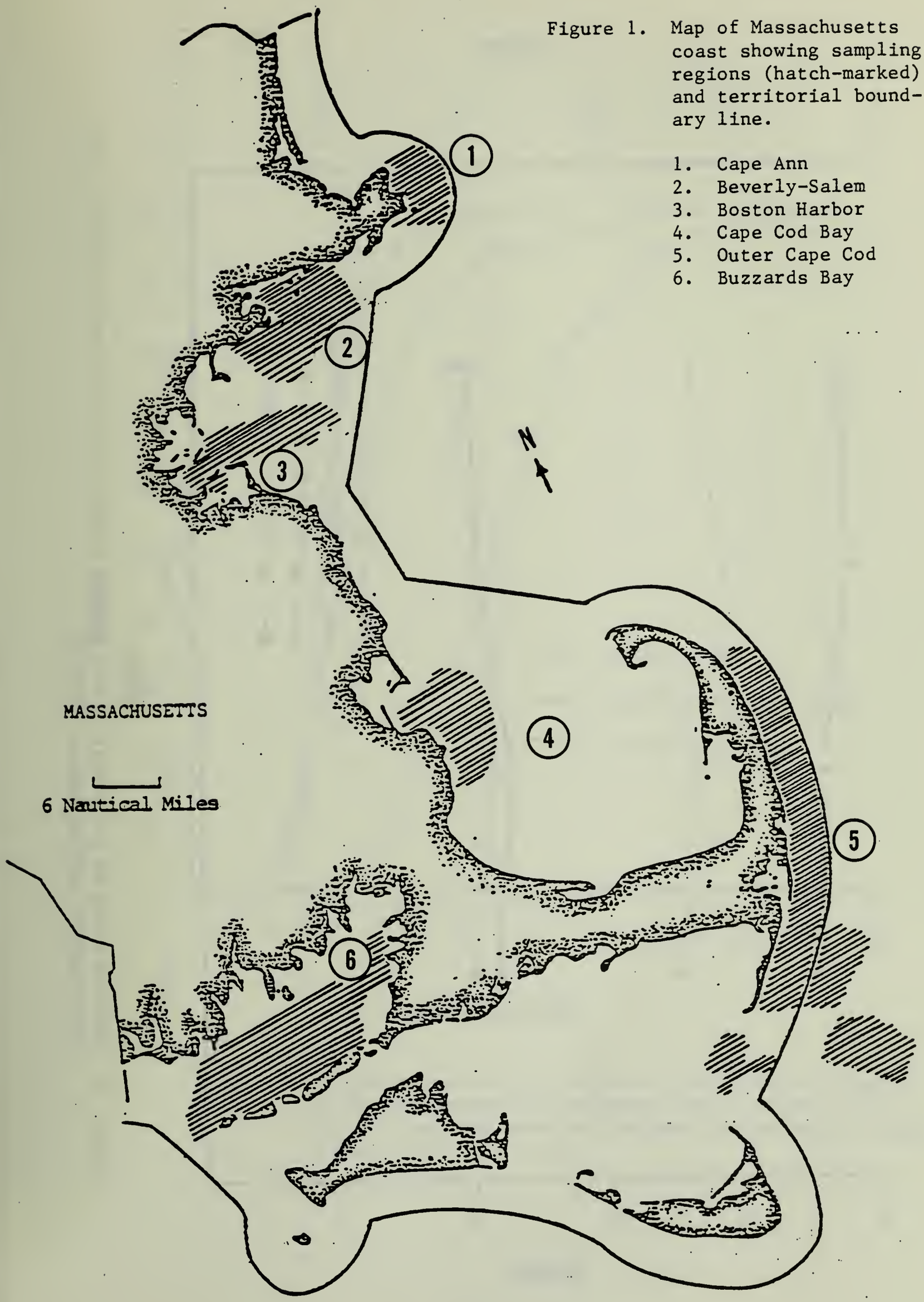

Figure 1. Map of Massachusetts coast showing sampling regions (hatch-marked) and territorial boundary line.

1. Cape Ann
2. Beverly-Salem
3. Boston Harbor
4. Cape Cod Bay
5. Outer Cape Cod
6. Buzzards Bay

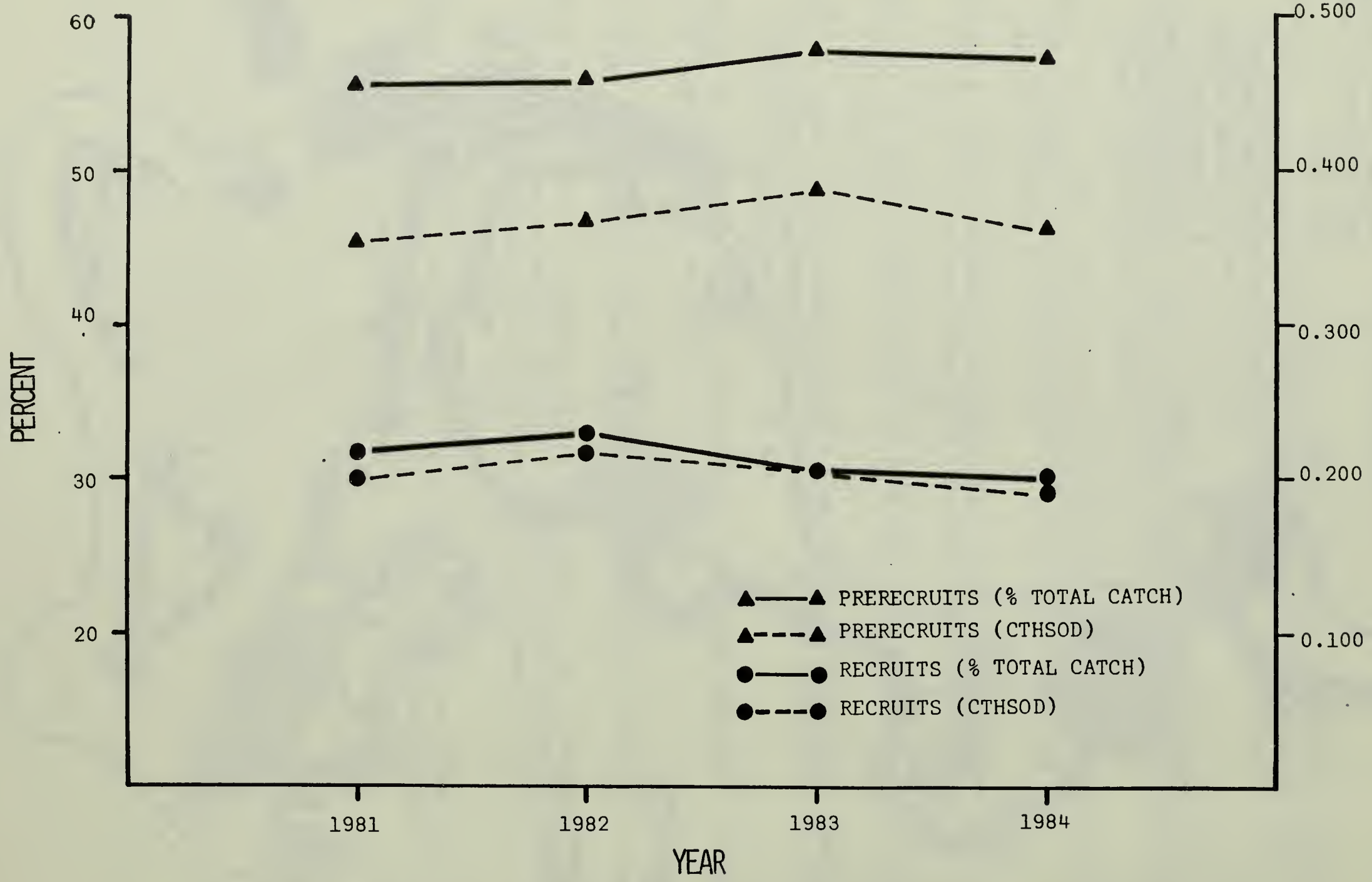

Figure 2. Relative sizes of prerecruit (69-80 mm) and recruit (81-93 mm) molt groups by year, Massachusetts coastal waters, 1981-84.

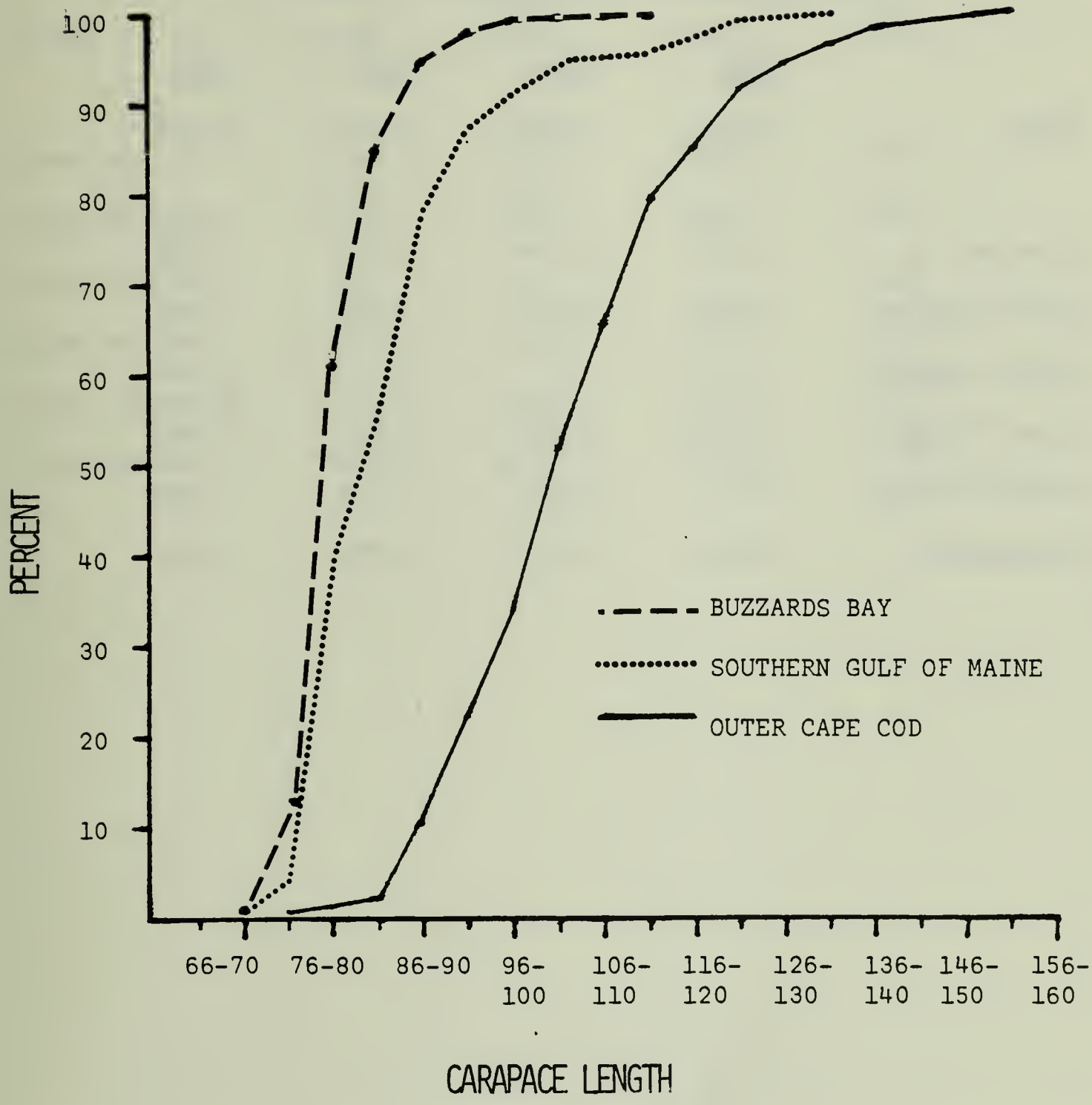

Figure 3. Cumulative percent of ovigerous female American lobster by 5mm size groups for southern Gulf of Maine, outer Cape Cod, and Buzzards Bay regions, Massachusetts coastal waters, 1984.

Table 1. CTHSOD by state and region for all American lobster sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	0.663	0.695	0.813	0.638
Cape Ann	0.225	0.394	0.864	0.720
Beverly-Salem	1.050	0.797	1.664	1.013
Boston Harbor	--	--	--	1.160
Cape Cod Bay	0.916	1.162	0.814	0.447
Outer Cape Cod	0.161	0.192	0.199	0.168
Buzzards Bay	1.001	0.741	0.904	1.026

Table 2. CTHSOD by state and region for all American lobster $\geq$ 81 mm sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	0.229	0.251	0.278	0.219
Cape Ann	0.169	0.310	0.293	0.286
Beverly-Salem	0.341	0.270	0.401	0.241
Boston Harbor	--	--	--	0.335
Cape Cod Bay	0.282	0.342	0.262	0.160
Outer Cape Cod	0.130	0.169	0.165	0.137
Buzzards Bay	0.218	0.191	0.341	0.348

Table 3. CTHSOD by state and region for all marketable American lobster sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	0.220	0.235	0.248	0.201
Cape Ann	0.167	0.305	0.276	0.276
Beverly-Salem	0.338	0.264	0.397	0.241
Boston Harbor	--	--	--	0.329
Cape Cod Bay	0.270	0.330	0.253	0.155
Outer Cape Cod	0.119	0.142	0.128	0.109
Buzzards Bay	0.201	0.165	0.271	0.283

Table 4. CTHSOD by state and region for all American lobster < 81 mm, sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	0.433	0.444	0.536	0.418
Cape Ann	0.056	0.084	0.572	0.435
Beverly-Salem	0.709	0.527	1.263	0.772
Boston Harbor	--	--	--	0.826
Cape Cod Bay	0.634	0.820	0.551	0.287
Outer Cape Cod	0.031	0.023	0.033	0.032
Buzzards Bay	0.783	0.548	0.562	0.667

Table 5. CTHAUL by state and region for all American lobster sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	2.252	2.193	2.466	2.118
Cape Ann	1.026	0.935	1.578	1.508
Beverly-Salem	2.749	2.590	3.328	3.286
Boston Harbor	--	--	--	3.898
Cape Cod Bay	2.232	2.380	1.984	1.285
Outer Cape Cod	1.200	1.217	1.262	1.007
Buzzards Bay	3.044	2.588	3.726	2.980

Table 6. CTHAUL by state and region for all American lobster ≥ 81 mm sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	0.779	0.792	0.842	0.728
Cape Ann	0.769	0.736	0.535	0.598
Beverly-Salem	0.893	0.878	0.802	0.782
Boston Harbor	--	--	--	0.125
Cape Cod Bay	0.687	0.700	0.639	0.461
Outer Cape Cod	0.968	1.072	1.052	0.818
Buzzards Bay	0.662	0.668	1.408	1.011

Table 7. CTHAUL by state and region for all marketable American lobster sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	0.747	0.740	0.753	0.668
Cape Ann	0.759	0.723	0.504	0.578
Beverly-Salem	0.884	0.857	0.793	0.780
Boston Harbor	--	--	--	1.107
Cape Cod Bay	0.658	0.677	0.617	0.446
Outer Cape Cod	0.887	0.896	0.811	0.650
Buzzards Bay	0.610	0.578	1.116	0.821

Table 8. CTHAUL by state and region for all American lobster < 81 mm sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	1.473	1.401	1.624	1.389
Cape Ann	0.256	0.199	1.044	0.909
Beverly-Salem	1.855	1.713	2.526	2.504
Boston Harbor	--	--	--	2.773
Cape Cod Bay	1.544	1.680	1.345	0.825
Outer Cape Cod	0.233	0.145	0.210	0.189
Buzzards Bay	2.381	1.916	2.316	1.965

Table 9. Estimated exploitation rates by state and region, commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	86	86	86	86
Cape Ann	91	92	87	89
Beverly-Salem	89	92	94	88
Boston Harbor	--	--	--	94
Cape Cod Bay	90	93	92	94
Outer Cape Cod	46	43	42	38
Buzzards Bay	98	96	96	94

Table 10. Total instantaneous (Z)* and total annual ($1-e^{-Z}$)** mortality estimates of American lobster by region and year, Massachusetts coastal waters, 1981-1984.

	1981		1982		1983		1984	
	Gulland (1969)	Beverton and Holt (1956)	Gulland (1969)	Beverton and Holt (1956)	Gulland (1969)	Beverton and Holt (1956)	Gulland (1969)	Beverton and Holt (1956)
Cape Ann	1.65* 81%**	1.32 73%	2.18 89%	1.39 75%	1.72 82%	1.35 74%	1.92 85%	1.52 78%
Beverly-Salem	1.97 86%	1.59 80%	2.15 88%	1.70 82%	2.41 91%	1.85 84%	2.71 93%	1.78 83%
Boston Harbor							2.52 92%	1.82 84%
Cape Cod Bay	2.53 92%	1.64 81%	2.69 93%	1.92 85%	2.42 91%	1.72 82%	2.52 92%	2.07 87%
Outer Cape Cod	0.43 35%	0.54 42%	0.46 37%	0.55 42%	0.42 34%	0.53 41%	0.33 28%	0.52 41%
Buzzards Bay	3.02 95%	2.97 95%	3.00 95%	2.53 92%	8.64 99%	2.26 90%	3.14 96%	2.21 89%
Regions combined	1.27 72%	1.07 66%	1.36 74%	1.12 67%	1.32 73%	1.10 67%	1.29 72%	1.15 68%

Table 11. Mean carapace length (mm) by state and region for all American lobster sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	81.7	82.1	81.7	81.7
Cape Ann	86.2	86.2	82.1	81.7
Beverly-Salem	78.2	80.0	77.9	78.3
Boston Harbor	--	--	--	79.8
Cape Cod Bay	80.0	79.5	80.0	79.3
Outer Cape Cod	95.5	96.0	95.9	96.5
Buzzards Bay	77.8	78.1	80.1	79.6

Table 12. Mean carapace length (mm) by state and region for all American lobster ≥ 81 mm, sampled during commercial lobster trap survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	90.6	90.2	90.4	90.5
Cape Ann	88.9	88.5	88.7	88.2
Beverly-Salem	87.6	87.2	86.7	86.9
Boston Harbor	--	--	--	86.9
Cape Cod Bay	87.4	86.5	87.1	86.2
Outer Cape Cod	99.1	98.9	99.5	101.1
Buzzards Bay	84.6	85.2	85.7	85.9

Table 13. Mean carapace length (mm) by state and region for all marketable American lobster sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	90.2	89.7	89.7	90.0
Cape Ann	88.6	88.3	88.3	87.9
Beverly-Salem	87.6	87.0	86.6	86.9
Boston Harbor	--	--	--	86.8
Cape Cod Bay	87.2	86.4	86.9	86.1
Outer Cape Cod	98.2	97.5	97.4	99.7
Buzzards Bay	84.7	85.2	85.7	85.8

Table 14. Mean carapace length (mm) by state and region for all American lobster < 81 mm, sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	75.8	76.3	76.2	76.1
Cape Ann	78.0	77.7	77.5	77.3
Beverly-Salem	74.3	76.5	74.9	76.1
Boston Harbor	--	--	--	77.1
Cape Cod Bay	76.6	76.4	76.7	75.6
Outer Cape Cod	75.9	76.2	77.1	75.1
Buzzards Bay	75.8	75.5	76.8	76.4

Table 15. Frequency of carapace length observations by number, percent, and cumulative percent, Massachusetts coastal waters, 1984.

CARAPACE LENGTH (mm)	NUMBER	PERCENT	CUMULATIVE PERCENT
28	1	.0	.0
34	0	.0	.0
37	1	.0	.0
38	0	.0	.0
41	1	.0	.0
42	1	.0	.0
43	3	.0	.0
44	1	.0	.1
45	5	.0	.1
46	1	.0	.1
47	4	.0	.1
48	4	.0	.1
49	5	.0	.2
50	1	.0	.2
51	13	.1	.3
52	13	.1	.3
53	9	.1	.4
54	9	.1	.4
55	16	.1	.5
56	20	.1	.7
57	16	.1	.8
58	17	.1	.9
59	19	.1	1.0
60	34	.2	1.2
61	37	.2	1.4
62	28	.2	1.6
63	46	.3	1.8
64	52	.3	2.2
65	53	.3	2.5
66	78	.5	3.0
67	80	.5	3.4
68	105	.6	4.1
69	101	.6	4.7
70	219	1.3	6.0
71	188	1.1	7.2
72	229	1.4	8.5
73	331	2.0	10.5
74	493	3.0	13.5
75	724	4.4	17.9
76	932	5.6	23.6
77	1100	6.7	30.2
78	1355	8.2	38.4
79	1610	9.8	48.2

Table 15. (continued)

CARAPACE LENGTH (mm)	NUMBER	PERCENT	CUMULATIVE PERCENT
80	2177	13.2	61.4
81	644	3.9	65.3
82	425	2.6	67.8
83	438	2.7	70.5
84	428	2.6	73.1
85	448	2.7	75.8
86	457	2.8	78.6
87	482	2.9	81.5
88	422	2.6	84.0
89	350	2.1	86.2
90	341	2.1	88.2
91	188	1.1	89.4
92	196	1.2	90.6
93	144	.9	91.4
94	129	.8	92.2
95	108	.7	92.9
96	90	.5	93.4
97	55	.3	93.7
98	52	.3	94.1
99	60	.4	94.4
100	34	.2	94.6
101	78	.5	95.1
102	58	.4	95.4
103	46	.3	95.7
104	35	.2	95.9
105	51	.3	96.2
106	40	.2	96.5
107	34	.2	96.7
108	27	.2	96.9
109	18	.1	97.0
110	42	.3	97.2
111	59	.4	97.6
112	18	.1	97.7
113	25	.2	97.8
114	23	.1	98.0
115	20	.1	98.1
116	44	.3	98.4
117	13	.1	98.4
118	20	.1	98.6
119	12	.1	98.6
120	17	.1	98.7
121	20	.1	98.9
122	11	.1	98.9
123	12	.1	99.0
124	8	.0	99.0

Table 15. (continued)

CARAPACE LENGTH (mm)	NUMBER	PERCENT	CUMULATIVE PERCENT
125	16	.1	99.1
126	4	.0	99.2
127	27	.2	99.3
128	20	.1	99.5
129	9	.1	99.5
130	9	.1	99.6
131	4	.0	99.6
132	2	.0	99.6
133	24	.1	99.7
134	1	.0	99.8
135	7	.0	99.8
136	5	.0	99.8
137	4	.0	99.8
138	6	.0	99.9
139	1	.0	99.9
140	2	.0	99.9
141	4	.0	99.9
142	3	.0	99.9
143	1	.0	99.9
146	1	.0	100.0
149	0	.0	100.0
153	4	.0	100.0
154	3	.0	100.0
164	2	.0	100.0
TOTAL	16513	100.0	

Table 16. Frequency of carapace length observations by numbers, percent, and cumulative percent for the Cape Ann region, Massachusetts coastal waters, 1984.

CARAPACE LENGTH (mm)	NUMBER	PERCENT	CUMULATIVE PERCENT
48	1	.0	.0
50	1	.0	.1
51	1	.0	.1
55	2	.1	.2
56	1	.0	.2
58	2	.1	.3
61	1	.1	.4
62	1	.0	.4
63	3	.2	.6
64	3	.2	.8
65	1	.1	.8
66	6	.3	1.2
67	2	.1	1.3
68	16	.9	2.2
69	5	.3	2.4
70	13	.7	3.1
71	11	.6	3.7
72	13	.7	4.4
73	26	1.4	5.9
74	55	3.0	8.9
75	53	2.9	11.8
76	93	5.1	16.9
77	114	6.3	23.2
78	142	7.8	31.0
79	191	10.9	41.4
80	324	17.8	59.2
81	65	3.6	62.8
82	47	2.6	65.4
83	69	3.8	69.2
84	57	3.1	72.3
85	59	3.2	75.5
86	54	3.0	78.5
87	56	3.1	81.5
88	62	3.4	84.9
89	61	3.3	88.3
90	50	2.8	91.0
91	31	1.7	92.7
92	31	1.7	94.5
93	13	.7	95.2

Table 16. (continued)

CARAPACE LENGTH (mm)	NUMBER	PERCENT	CUMULATIVE PERCENT
94	9	.5	95.7
95	10	.6	96.2
96	7	.4	96.6
97	4	.2	96.8
98	1	.1	96.9
99	5	.3	97.1
100	1	.0	97.2
101	6	.3	97.5
102	9	.5	98.0
103	3	.2	98.2
104	5	.3	98.5
105	6	.3	98.8
107	2	.1	98.9
108	3	.1	99.0
111	1	.1	99.1
112	1	.0	99.1
113	3	.2	99.3
114	1	.1	99.4
115	1	.1	99.5
116	1	.1	99.5
118	3	.2	99.7
120	1	.1	99.7
121	1	.1	99.8
123	1	.1	99.9
126	1	.0	99.9
130	1	.1	100.0
TOTAL	1823	100.0	

Table 17. Frequency of carapace length observations by numbers, percent, and cumulative percent for the Beverly-Salem region, Massachusetts Coastal waters, 1984.

CARAPACE LENGTH (mm)	NUMBER	PERCENT	CUMULATIVE PERCENT
54	1	.1	.1
60	1	.1	.1
61	3	.3	.4
62	2	.2	.6
63	1	.1	.7
64	8	.7	1.4
65	2	.2	1.6
66	5	.4	2.0
67	6	.5	2.5
68	11	.9	3.5
69	12	1.0	4.5
70	41	3.4	7.9
71	22	1.9	9.8
72	24	2.0	11.8
73	25	2.1	13.9
74	61	5.2	19.1
75	88	7.4	26.5
76	114	9.6	36.1
77	121	10.2	46.3
78	118	10.0	56.3
79	94	7.9	64.2
80	177	14.9	79.1
81	18	1.5	80.6
82	27	2.2	82.9
83	13	1.1	84.0
84	27	2.3	86.3
85	22	1.8	88.1
86	27	2.2	90.3
87	25	2.1	92.5
88	23	1.9	94.4
89	14	1.2	95.6
90	11	.9	96.5
91	4	.3	96.8
92	9	.7	97.6
93	4	.4	97.9
94	8	.6	98.6
95	5	.4	99.0
96	1	.1	99.1
97	3	.2	99.3
99	1	.1	99.4
102	3	.3	99.7
103	2	.2	99.9
108	1	.1	100.0
TOTAL	1186	100.0	

Table 18. Frequency of carapace length observations by number, percent, and cumulative percent for the Boston Harbor region, Massachusetts coastal waters, 1984.

CARAPACE LENGTH (mm)	NUMBER	PERCENT	CUMULATIVE PERCENT
28	1	.0	.0
34	1	.0	.1
38	1	.0	.1
41	1	.0	.1
45	1	.0	.1
47	1	.0	.1
49	1	.0	.2
51	1	.0	.2
55	1	.0	.2
57	2	.0	.3
60	1	.0	.3
61	2	.0	.3
62	1	.0	.3
63	3	.1	.4
64	1	.0	.5
65	6	.1	.6
66	4	.1	.7
67	6	.1	.8
68	8	.2	1.0
69	13	.3	1.3
70	30	.7	2.0
71	30	.7	2.7
72	71	1.7	4.5
73	90	2.1	6.6
74	136	3.3	9.9
75	301	7.2	17.1
76	291	7.0	24.0
77	325	7.8	31.8
78	445	10.6	42.5
79	476	11.4	53.9
80	772	18.5	72.4
81	126	3.0	75.4
82	77	1.8	77.2
83	88	2.1	79.3
84	74	1.8	81.1
85	106	2.5	83.6
86	124	3.0	86.6
87	97	2.3	88.9
88	98	2.3	91.3

Table 18. (continued)

CARAPACE LENGTH (mm)	NUMBER	PERCENT	CUMULATIVE PERCENT
89	73	1.8	93.0
90	107	2.6	95.6
91	43	1.0	96.6
92	33	.8	97.4
93	39	.9	98.3
94	21	.5	98.8
95	12	.3	99.1
96	12	.3	99.4
97	6	.1	99.5
98	2	.1	99.6
99	2	.1	99.6
100	4	.1	99.7
102	1	.0	99.7
106	1	.0	99.8
108	1	.0	99.8
109	1	.0	99.8
110	4	.1	99.9
115	1	.0	100.0
117	1	.0	100.0
133	1	.0	100.0
TOTAL	4176	100.0	

Table 19. Frequency of carapace length observations by number, percent, and cumulative percent for the Cape Cod Bay region, Massachusetts coastal waters, 1984.

CARAPACE LENGTH (mm)	NUMBER	PERCENT	CUMULATIVE PERCENT
37	1	.0	.0
41	1	.0	.0
42	1	.0	.0
43	2	.1	.1
44	1	.0	.1
45	4	.1	.2
46	1	.0	.2
47	3	.1	.3
48	3	.1	.3
49	3	.1	.4
51	7	.2	.5
52	9	.2	.7
53	5	.1	.8
54	4	.1	.9
55	11	.2	1.1
56	12	.3	1.4
57	12	.2	1.6
58	10	.2	1.9
59	8	.2	2.0
60	19	.4	2.4
61	17	.4	2.8
62	12	.3	3.1
63	20	.4	3.5
64	22	.5	4.0
65	23	.5	4.4
66	34	.7	5.2
67	35	.8	5.9
68	36	.8	6.7
69	35	.8	7.4
70	59	1.3	8.7
71	62	1.3	10.0
72	59	1.3	11.3
73	106	2.3	13.6
74	134	2.9	16.4
75	151	3.2	19.7
76	242	5.2	24.9
77	330	7.1	31.9
78	380	8.1	40.1
79	569	12.2	52.3
80	596	12.8	65.0

Table 19. (continued)

CARAPACE LENGTH (mm)	NUMBER	PERCENT	CUMULATIVE PERCENT
81	260	5.6	70.6
82	147	3.2	73.8
83	140	3.0	76.8
84	145	3.1	79.9
85	116	2.5	82.4
86	125	2.7	85.0
87	158	3.4	88.4
88	108	2.3	90.7
89	119	2.5	93.3
90	73	1.6	94.8
91	55	1.2	96.0
92	48	1.0	97.0
93	37	.8	97.8
94	39	.8	98.7
95	17	.4	99.0
96	5	.1	99.2
97	7	.1	99.3
98	4	.1	99.4
99	2	.0	99.4
100	1	.0	99.4
101	4	.1	99.5
103	4	.1	99.6
104	3	.1	99.7
105	4	.1	99.7
107	1	.0	99.8
108	2	.0	99.8
109	1	.0	99.8
110	2	.0	99.9
111	1	.0	99.9
114	2	.1	99.9
118	1	.0	99.9
119	1	.0	99.9
124	2	.0	100.0
130	1	.0	100.0
TOTAL	4668	100.0	

Table 20. Frequency of carapace length observations by numbers, percent, and cumulative percent for the outer Cape Cod region, Massachusetts coastal waters, 1984.

CARAPACE LENGTH (mm)	NUMBER	PERCENT	CUMULATIVE PERCENT
51	2	.1	.1
53	1	.1	.2
54	2	.1	.3
56	2	.1	.4
58	1	.1	.5
59	4	.3	.8
60	2	.1	.9
61	2	.2	1.1
62	1	.1	1.2
63	3	.2	1.4
64	1	.0	1.4
65	4	.3	1.8
66	3	.2	2.0
67	2	.2	2.2
68	3	.2	2.4
69	3	.2	2.6
70	2	.1	2.7
71	4	.3	3.0
72	9	.7	3.7
73	7	.5	4.3
74	10	.8	5.1
75	15	1.2	6.2
76	14	1.1	7.3
77	17	1.3	8.7
78	40	3.2	11.8
79	29	2.2	14.1
80	45	3.6	17.6
81	18	1.4	19.0
82	19	1.5	20.5
83	19	1.5	21.9
84	18	1.4	23.3
85	31	2.4	25.7
86	36	2.8	28.6
87	44	3.4	32.0
88	51	4.0	36.0
89	24	1.9	37.9
90	56	4.4	42.3
91	24	1.9	44.2
92	36	2.8	47.0
93	27	2.1	49.1

Table 20. (continued)

CARAPACE LENGTH (mm)	NUMBER	PERCENT	CUMULATIVE PERCENT
94	16	1.2	50.4
95	33	2.6	53.0
96	37	2.9	55.9
97	19	1.5	57.4
98	26	2.1	59.4
99	30	2.3	61.8
100	15	1.1	62.9
101	41	3.2	66.1
102	26	2.0	68.1
103	20	1.6	69.7
104	16	1.3	70.9
105	25	1.9	72.9
106	23	1.8	74.7
107	19	1.5	76.1
108	12	.9	77.1
109	10	.8	77.9
110	22	1.8	79.6
111	34	2.7	82.3
112	10	.8	83.1
113	13	1.0	84.1
114	11	.9	85.0
115	11	.9	85.9
116	26	2.0	87.9
117	7	.6	88.5
118	10	.8	89.3
119	7	.5	89.8
120	10	.8	90.6
121	11	.9	91.5
122	7	.5	92.0
123	7	.5	92.5
124	3	.3	92.8
125	10	.8	93.5
126	2	.2	93.7
127	16	1.3	94.9
128	12	1.0	95.9
129	5	.4	96.3
130	4	.3	96.7
131	3	.2	96.9
132	1	.1	96.9
133	14	1.1	98.0
134	1	.0	98.1
135	4	.3	98.4
136	3	.2	98.6

Table 20. (continued)

CARAPACE LENGTH (mm)	NUMBER	PERCENT	CUMULATIVE PERCENT
137	2	.2	98.8
138	3	.3	99.1
139	1	.0	99.1
140	1	.1	99.2
141	2	.2	99.4
142	2	.1	99.5
143	1	.0	99.6
146	1	.1	99.6
153	2	.2	99.8
154	2	.1	99.9
164	1	.1	100.0
TOTAL	1274	100.0	

Table 21. Frequency of carapace length observations by number, percent, and cumulative percent for the Buzzards Bay region, Massachusetts coastal waters, 1984.

CARAPACE LENGTH (mm)	NUMBER	PERCENT	CUMULATIVE PERCENT
50	1	.0	.0
53	1	.0	.1
54	1	.0	.1
56	1	.0	.1
58	2	.1	.2
59	3	.1	.2
60	3	.1	.3
61	4	.1	.4
62	6	.2	.6
63	12	.4	1.0
64	5	.1	1.1
65	11	.3	1.5
66	17	.5	2.0
67	18	.5	2.5
68	22	.7	3.1
69	23	.7	3.8
70	55	1.6	5.4
71	49	1.5	6.9
72	62	1.8	8.7
73	91	2.7	11.4
74	102	3.0	14.5
75	199	5.9	20.3
76	218	6.4	26.8
77	217	6.4	33.2
78	316	9.3	42.5
79	333	9.8	52.3
80	468	13.8	66.1
81	163	4.8	71.0
82	100	3.0	73.9
83	132	3.9	77.8
84	102	3.0	80.8
85	142	4.2	85.0
86	104	3.1	88.1
87	83	2.4	90.5
88	75	2.2	92.7
89	56	1.7	94.4
90	49	1.4	95.8
91	31	.9	96.7
92	21	.6	97.4
93	17	.5	97.9

Table 21. (continued)

CARAPACE LENGTH (mm)	NUMBER	PERCENT	CUMULATIVE PERCENT
94	26	.8	98.6
95	9	.3	98.9
96	10	.3	99.2
97	6	.2	99.4
98	2	.0	99.4
99	2	.0	99.5
100	8	.2	99.7
101	1	.0	99.7
102	3	.1	99.8
103	2	.0	99.8
106	1	.0	99.9
107	2	.0	99.9
108	1	.0	99.9
113	2	.0	100.0
149	1	.0	100.0
TOTAL	3386	100.0	

Table 22. Carapace lengths and expected weights for coastal Massachusetts lobster.

Carapace Length (mm)	Expected Weights: Sexes Combined	Males	Females
81	431.39	424.56	437.15
82	447.64	441.07	453.21
83	464.30	458.01	469.66
84	481.36	475.38	486.50
85	498.84	493.20	503.73
86	516.74	511.47	521.36
87	535.06	530.19	539.39
88	553.81	549.37	557.83
89	573.00	569.01	576.68
90	592.63	589.13	595.95
91	612.69	609.72	615.64
92	633.21	630.80	635.75
93	654.19	652.36	656.29
94	675.62	674.42	677.26
95	697.51	696.98	698.67
96	719.88	720.04	720.52
97	742.72	743.62	742.82
98	766.03	767.72	765.57
99	789.84	792.34	788.78
100	814.13	817.49	812.44
101	838.91	843.10	836.57
102	864.20	869.41	861.16
103	889.99	896.18	886.23
104	916.28	923.52	911.78
105	943.10	951.41	937.81
106	970.43	979.86	964.32
107	998.28	1008.89	991.32
108	1026.67	1038.50	1018.82
109	1055.59	1068.69	1046.81
110	1085.05	1099.47	1075.31
111	1115.05	1130.85	1104.32
112	1145.60	1162.83	1133.84
113	1176.71	1195.42	1163.87
114	1208.37	1228.62	1194.42
115	1240.61	1262.44	1225.50
116	1273.41	1296.88	1257.11
117	1306.78	1331.96	1289.25
118	1340.73	1367.68	1321.93
119	1375.27	1404.04	1355.15
120	1410.40	1441.05	1388.92

Table 23. Percent of females ovigerous by state and region for all American lobster sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	5.9	7.7	10.9	9.1
Cape Ann	1.7	3.1	4.4	3.2
Beverly-Salem	1.7	2.8	1.2	0.4
Boston Harbor	--	--	--	1.4
Cape Cod Bay	3.9	3.1	3.7	3.1
Outer Cape Cod	11.1	23.0	30.3	26.8
Buzzards Bay	16.0	16.9	32.5	26.6

Table 24. Percent of females ovigerous by state and region for all American lobster ≥ 81 mm, sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	8.5	13.3	18.9	16.2
Cape Ann	2.5	3.7	9.6	6.3
Beverly-Salem	2.8	6.3	2.9	1.1
Boston Harbor	--	--	--	3.2
Cape Cod Bay	8.0	5.9	7.0	5.5
Outer Cape Cod	12.9	25.6	34.5	32.2
Buzzards Bay	17.0	24.6	30.0	28.5

Table 25. Percent of females ovigerous by state and region for American lobster < 81 mm, sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	4.3	4.1	6.4	5.1
Cape Ann	0.0	1.6	1.3	1.2
Beverly-Salem	1.3	1.5	0.7	0.3
Boston Harbor	--	--	--	0.7
Cape Cod Bay	2.2	2.2	2.4	2.0
Outer Cape Cod	0.0	2.1	1.0	1.4
Buzzards Bay	15.7	14.2	34.0	25.5

Table 26. Mean carapace length (mm) of all ovigerous female American lobster by state and region sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	88.5	87.6	88.6	87.4
Cape Ann	109.0	100.3	94.3	90.5
Beverly-Salem	80.5	84.5	85.8	83.5
Boston Harbor	--	--	--	82.1
Cape Cod Bay	86.4	83.8	85.5	84.4
Outer Cape Cod	109.8	106.1	108.0	107.1
Buzzards Bay	78.1	79.6	81.6	83.0

Table 27. Mean carapace length (mm) of ovigerous female American lobster ≥ 81 mm, sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	98.2	94.4	94.4	94.0
Cape Ann	109.0	102.6	96.1	95.0
Beverly-Salem	89.3	87.8	90.6	90.0
Boston Harbor	--	--	--	91.0
Cape Cod Bay	91.9	91.0	91.2	88.9
Outer Cape Cod	109.8	106.2	108.1	107.4
Buzzards Bay	84.5	84.7	86.3	91.0

Table 28. Mean carapace length (mm) of ovigerous female American lobster < 81 mm, sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	77.3	77.9	77.9	76.4
Cape Ann	--*	80.0	78.5	79.9
Beverly-Salem	77.2	77.3	77.8	77.0
Boston Harbor	--	--	--	70.2
Cape Cod Bay	77.7	78.4	78.0	77.4
Outer Cape Cod	--*	77.0	80.0	76.8
Buzzards Bay	76.9	77.3	77.6	77.4

*None captured.

Table 29. Percent of ovigerous female American lobster ≥ 81 mm carapace length, by state and region, commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	55.3	67.0	60.0	62.7
Cape Ann	100.0	88.0	82.0	78.4
Beverly-Salem	46.5	64.0	52.0	48.5
Boston Harbor	--	--	--	59.5
Cape Cod Bay	60.1	49.0	53.0	54.9
Outer Cape Cod	100.0	99.0	99.5	99.1
Buzzards Bay	23.7	39.0	35.0	37.2

Table 30. Percent of male American lobster, by state and region sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	42.0	41.0	41.0	38.0
Cape Ann	42.0	46.0	39.0	35.0
Beverly-Salem	44.0	41.0	51.0	50.0
Boston Harbor	--	--	--	40.0
Cape Cod Bay	39.0	36.0	36.0	36.0
Outer Cape Cod	44.0	46.0	44.0	41.0
Buzzards Bay	43.0	47.0	36.0	34.0

Table 31. Percent of male American lobster ≥ 81 mm, by state and region, sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	44.0	47.0	45.0	41.0
Cape Ann	47.0	51.0	42.0	36.0
Beverly-Salem	47.0	49.0	62.0	59.0
Boston Harbor	--	--	--	45.0
Cape Cod Bay	43.0	45.0	45.0	43.0
Outer Cape Cod	43.0	44.0	41.0	41.0
Buzzards Bay	44.0	48.0	35.0	31.0

Table 32. Percent of male American lobster < 81 mm, by state and region, sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	40.0	37.0	38.0	36.0
Cape Ann	24.0	30.0	36.0	35.0
Beverly-Salem	43.0	37.0	47.0	47.0
Boston Harbor	--	--	--	38.0
Cape Cod Bay	37.0	33.0	31.0	32.0
Outer Cape Cod	53.0	54.0	55.0	44.0
Buzzards Bay	42.0	47.0	37.0	35.0

Table 33. Cull rate (percent) by state and region for all American lobster sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	10.0	10.8	10.7	14.8
Cape Ann	10.0	9.8	10.5	11.5
Beverly-Salem	8.3	8.6	10.2	20.9
Boston Harbor	--	--	--	13.3
Cape Cod Bay	11.1	10.7	10.9	15.6
Outer Cape Cod	5.7	11.3	8.9	13.0
Buzzards Bay	13.5	14.7	12.4	12.4

Table 34. Cull rate (percent) by state and region for all American lobster ≥ 81 mm, sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	8.1	9.7	9.2	12.7
Cape Ann	10.7	9.6	7.5	10.4
Beverly-Salem	4.3	7.7	7.4	15.5
Boston Harbor	--	--	--	10.1
Cape Cod Bay	9.3	9.3	10.0	13.2
Outer Cape Cod	5.3	10.3	8.1	13.3
Buzzards Bay	16.1	13.2	12.7	12.3

Table 35. Cull rate (percent) by state and region for all marketable American lobster sampled during commercial lobster catch trap survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	8.2	9.9	9.2	15.0
Cape Ann	10.8	9.8	7.3	11.5
Beverly-Salem	4.4	8.0	7.4	20.9
Boston Harbor	--	--	--	13.3
Cape Cod Bay	9.3	9.3	10.0	15.6
Outer Cape Cod	5.3	10.9	8.6	14.2
Buzzards Bay	16.9	13.1	12.3	12.5

Table 36. Cull rate (percent) by state and region for all American lobster < 81 mm, sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	11.2	11.5	11.6	16.1
Cape Ann	8.0	10.6	12.6	12.2
Beverly-Salem	10.0	9.0	11.2	22.3
Boston Harbor	--	--	--	14.5
Cape Cod Bay	11.9	11.3	11.4	17.0
Outer Cape Cod	7.8	17.9	13.5	11.7
Buzzards Bay	12.7	15.2	12.2	12.4

Table 37. Percent trap mortality by state and region for all American lobster sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	0.15	0.04	0.22	0.15
Cape Ann	0.00	0.00	0.09	0.27
Beverly-Salem	0.00	0.00	0.00	0.00
Boston Harbor	--	--	--	0.00
Cape Cod Bay	0.00	0.02	0.03	0.00
Outer Cape Cod	0.46	0.22	0.23	0.48
Buzzards Bay	0.62	0.00	1.13	0.43

Table 38. Percent trap mortality by state and region for all American lobster ≥ 81 mm, sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	0.16	0.04	0.26	0.20
Cape Ann	0.00	0.00	0.00	0.10
Beverly-Salem	0.00	0.00	0.00	0.00
Boston Harbor	--	--	--	0.00
Cape Cod Bay	0.00	0.00	0.00	0.00
Outer Cape Cod	0.39	0.16	0.18	0.51
Buzzards Bay	0.62	0.00	1.46	0.40

Table 39. Percent trap mortality by state and region for all American lobster < 81 mm, sampled during commercial lobster trap catch survey, Massachusetts coastal waters, 1981-1984.

	1981	1982	1983	1984
State	0.15	0.03	0.20	0.12
Cape Ann	0.00	0.00	0.14	0.39
Beverly-Salem	0.00	0.00	0.00	0.00
Boston Harbor	--	--	--	0.00
Cape Cod Bay	0.00	0.03	0.05	0.00
Outer Cape Cod	0.87	0.65	0.50	0.31
Buzzards Bay	0.62	0.00	0.94	0.45

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